REPORT NUMBER: 301-CAL-03-01

SAFETY COMPLIANCE TESTING FOR FMVSS 301
FUEL SYSTEM INTEGRITY

VOLVO GOTHENBURG SWEDEN
2003 VOLVO V70
STATION WAGON

NHTSA NUMBER: C35900

VERIDIAN TEST NUMBER: 8655-F301-10

July 22, 2003

VERIDIAN ENGINEERING
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BUFFALO, NEW YORK 14225

FINAL REPORT

PREPARED FOR:

U. S. Department of Transportation
National Highway Traffic Safety Administration
Safety Assurance
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Approval Date: _____

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By: _____

Acceptance Date: _____

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. 301-CAL-03-01	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Final Report of FMVSS 301 Compliance Testing of a 2003 Volvo V70 Station Wagon NHTSA No. C35900		5. Report Date July 22, 2003 6. Performing Organization Code CAL
7. Author(s) Lawrence Q. Valvo, Project Engineer David J. Travale, Program Manager		8. Performing Organization Report No. 8655-F301-10
9. Performing Organization Name and Address Veridian Engineering 4455 Genesee Street Buffalo, New York 14225		10. Work Unit No. 11. Contract or Grant No. DTNH22-01-C-01025
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Vehicle Safety Compliance (NVS-220) 400 Seventh St , S.W., Rm. 6115, Washington, D.C. 20590		13. Type of Report and Period Covered Final Test Report 14. Sponsoring Agency Code NVS-220
15. Supplementary Notes		

16. Abstract

Compliance tests were conducted on the subject 2003 Volvo V70 Station Wagon in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-301-03 for the determination of FMVSS 301 compliance. For the purpose of acquiring information for applied research, two instrumented Anthropomorphic Test Devices (ATDs) were placed in the front occupant seating positions and various instrumentation was added to the test vehicle. Test failures identified were as follows:

The test vehicle appeared to comply with all requirements of FMVSS 301 "Fuel System Integrity."

17. Key Words Compliance Testing Safety Engineering FMVSS 301	18. Distribution Statement Copies of this report are available from: NHTSA Technical Reference Division Room 5108 (NPO-230), 400 Seventh , S.W., Washington, D.C. 20590 Telephone No. (202) 366-4946		
19. Security Classif. (of this report) UNCLASSIFIED	20. Security Classif. (of this page) UNCLASSIFIED	21. No. of Pages 40	22. Price

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SECTION 1

PURPOSE OF COMPLIANCE TEST

This 30 mph rear moving barrier impact test is part of the Federal Motor Vehicle Safety Standard (FMVSS) 301 Compliance Test Program conducted for the National Highway Traffic Safety Administration (NHTSA) by Veridian Engineering under Contract No. DTNH22-01-C-01025. The purpose of this test was to determine if the subject vehicle, a 2003 Volvo V70 Station Wagon, meets the performance requirements of FMVSS No. 301, "Fuel System Integrity." This compliance test was conducted using the requirements found in the OVSC Laboratory Test Procedure No. TP-301-03, dated February 28, 2003.

SECTION 2

COMPLIANCE TEST RESULTS SUMMARY

A 1818.9 kg 2003 Volvo V70 Station Wagon was impacted from the rear by an 1797 pound moving barrier at a velocity of 46.51 kph (28.9 mph). The test was performed by Veridian Engineering on July 22, 2003.

The test vehicle was equipped with a 70 liter fuel tank which was filled to 92 percent capacity with stoddard fluid prior to impact. Additional ballast (20.4 kg) was secured in the engine compartment area. For the purpose of acquiring information for applied research, one instrumented Part 572 O 5th percentile female Anthropomorphic Test Device (ATD) and one instrumented Part 572 E 50th percentile male ATD were placed in the front occupant seating positions and various instruments were added to the test vehicle. Research data is presented in a separate report.

The crash event was recorded by ten high-speed cameras and one real-time camera. Camera locations and other pertinent camera information are found on pages 3-9 and 3-10 of this report. Pre- and post-test photographs of the vehicle can be found in Appendix A.

There was no fuel system fluid spillage following the impact or during any portion of the static rollover test. The average vehicle longitudinal crush was 238 millimeters. The vehicle appeared to comply with all the requirements of FMVSS No. 301 "Fuel System Integrity."

SECTION 3

COMPLIANCE TEST DATA

DATA SHEET 1

TEST VEHICLE SPECIFICATIONS

TEST VEHICLE INFORMATION:

Year/Make/Model/Body Style: 2003 Volvo V70 Station Wagon

NHTSA No.: C35900 ; Color: Black

Engine Data: 5 Cylinders; - CID; 2.4 Liters; - cc

Placement: - Longitudinal or In-Line; X Transverse or Lateral

Transmission Data: 5 Speeds; - Manual; X Automatic; X Overdrive

Final Drive: - Rear Wheel Drive; X Front Wheel Drive; - Four Wheel Drive

Major Options: X A/C; X Power Steering; X Power Brakes

X Power Windows; X Power Door Locks; X Tilt Wheel

Date Received: 4/9/03 ; Odometer Reading 254 km

Selling Dealer: Best Motors

& Address: 1500 University Ave. Rochester, NY 14610

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured by: Volvo Gothenburg Sweden

Date of Manufacture: 01/03

VIN: YV1SW61T932321959

GVWR: 2127 kg; GAWR-FRONT: 1057 kg; GAWR-REAR: 1120 kg

DATA FROM VEHICLE'S TIRE LABEL:

Location of Placard on Vehicle: Fuel filler door

Recommended Tire Size: 195/65R15

* Recommended Cold Tire Pressure: FRONT: 221 kPa; REAR: 207 kPa

DATA FROM TIRE SIDEWALL:

Size of Tires on Test Vehicle: P195/65R15 Manufacturer: Michelin

Tire Pressure with Maximum Capacity Vehicle Load: FRONT: 303 kPa; REAR: 303 kPa

Type of Spare Tire: Temporary T128/80R17

VEHICLE CAPACITY DATA:

Type of Front Seats: - Bench; X Bucket; - Split Bench

Number of Occupants: 2 Front; 3 Rear; 5 Total

Vehicle Capacity Weight (VCW) = 421.8 kg

No. of Occupants x 68.04 kg = 340.2 kg

Rated Cargo/Luggage Weight (RCLW) = 81.6 kg

*Tire pressure used for test

DATA SHEET 2

PRE-TEST DATA

WEIGHT OF TEST VEHICLE AS RECEIVED FROM DEALER (with maximum fluids)= UDW:

Right Front =	439.5	kg	Right Rear =	346.5	kg
Left Front =	453.1	kg.	Left Rear =	357.0	kg
TOTAL FRONT =	892.6	kg	TOTAL REAR =	703.5	kg

TOTAL DELIVERED WEIGHT = 1596.1 kg

% of Total Front of Vehicle Weight = 55.9% of Total Rear Weight = 44.1%

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

Total Delivered Weight	=	1596.1 kg
Rated Cargo/Luggage Weight (RCLW)	=	81.6 kg
Weight of 2 p.572 Dummies, 74.4 kg	=	148.8 kg
TARGET TEST WEIGHT	=	1826.5 kg

WEIGHT OF TEST VEHICLE WITH TWO DUMMIES AND 74.0 KG OF CARGO WEIGHT:

Right Front =	535.2	kg	Right Rear =	378.3	kg
Left Front =	527.1	kg	Left Rear =	378.3	kg
TOTAL FRONT =	1062.3	kg	TOTAL REAR =	756.6	kg

TOTAL TEST WEIGHT = 1818.9 kg

% of Total Front of Vehicle Weight = 58.4% of Total Rear Weight = 41.6%

* Weight of Ballast Secured in Vehicle Trunk Area = 20.4 kg

Type of Ballast: Canvas bags containing lead shot

Method of Securing Ballast: Wedged between back of engine and firewall

Vehicle Components Removed for Weight Reduction: None

VEHICLE ATTITUDE (all dimension in millimeters):

AS DELIVERED:	RF	695	LF	687	RR	705	LR 705
AS TESTED:	RF	654	LF	648	RR	701	LR 700

Vehicle's Wheel Base: 2758 mm

Location of Vehicle's C.G.: 1147 millimeters rearward of front wheel center.

FUEL SYSTEM DATA:

Fuel System Capacity From Owner's Manual = 70.0 liters

Usable Capacity Figure Furnished by COTR = 70.0 liters

Test Volume Range (91 to 94% of Usable Capacity) = 63.7 to 65.8 liters

ACTUAL TEST VOLUME= 64.4 liters (with entire fuel system filled)

* Ballast weight includes the RCLW, the weight of drained vehicle fluids and the weight of any removed vehicle components less the weight of onboard instrumentation, cameras, and hardware.

DATA SHEET 2 (continued)

PRE-TEST DATA

FUEL SYSTEM DATA (continued):

Test Fluid Type: Stoddard Solution

Test Fluid Specific Gravity: 0.764

Test Fluid Kinematic Viscosity: 0.96 centistokes

Test Fluid Color: Orange ("red" is preferred)

Type of Vehicle Fuel Pump: Electric

Electric Fuel Pump Operation with Ignition Switch ON and Engine OFF -

When ignition is switched on without starting the engine, the fuel pump operates for several seconds then shuts off.

Details of Fuel System: Fuel filler is located on the right rear quarter panel aft of the rear axle; Fuel tank is located on the vehicle underbody beneath the rear seat and forward of the rear axle; Fuel lines are routed along the right side of the vehicle underbody.

Comments: None

DATA SHEET 3

MOVING BARRIER DATA

WEIGHT OF MOVING BARRIER:

Right Front	=	504.9 kg	Right Rear	=	393.7 kg.
Left Front	=	499.9 kg	Left Rear	=	398.3 kg
TOTAL FRONT	=	1004.8 kg	TOTAL REAR	=	792.0 kg

TOTAL BARRIER WEIGHT = 1796.8 kg

MOVING BARRIER DIMENSIONS:

Barrier Face Height: 1524 mm

Barrier Face Width: 1981 mm

Barrier Face Ground Clearance: 127 mm

Tread Width: 1511 mm

Wheel Base: 3048 mm

Location of C.G.: X: 1344 mm rearward of front wheel center.

Y: 0 mm from longitudinal-vertical plane of symmetry.

Z: 414 mm above ground.

MOVING BARRIER TIRES:

Manufacturer: Classic

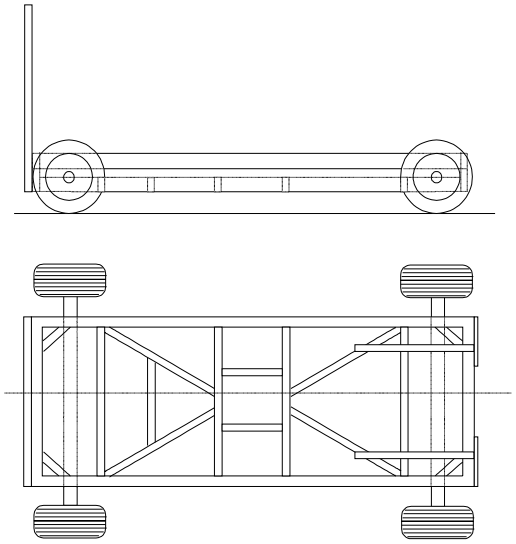
Model: Poly IV

Size: 215/75D15

Recommended Max Pressure: 240 kPa:

MOVING BARRIER ABORT SYSTEM:

Type: Trailing cable



DATA SHEET 4

POST TEST DATA

TYPE OF TEST:

Type of Test: Rear Barrier Impact Angle: 0º

Test Date: July 22, 2003 Time:: 15:57 Temperature: 22.8 °C

Vehicle NHTSA No.: C35900 VIN: YV1SW61T932321959

Required Impact Velocity Range: 46.51 to 48.12 kph

BARRIER IMPACT VELOCITY: (Speed traps within 5 feet of impact plane.)

Trap No. 1 = 46.51 kph; Trap No. 2 = 46.51 kph

Average Impact Speed = 46.51 kph

VEHICLE STATIC CRUSH:

Vehicle Length:

Pre-Test	Left =	4585	; C/L =	4711	Right =	4586
Post-Test	Left =	4341	; C/L =	4466	Right =	4362
Crush	Left =	244	; C/L =	245	Right =	224

AVERAGE = 238 millimeters

DATA SHEET 4 (continued)

POST TEST DATA

TEST VEHICLE NHTSA NO.: C35900 TEST DATE: July 22, 2003

Vehicle Mfgr./Make/Model: 2003 Volvo V70 Station Wagon

Test vehicle fuel tank filled to 91% to 94% of manufacturer's "usable" capacity and with electric fuel pump operating (if it will operate without engine operation). Part 572 test dummies located at each front designated seating position.

****

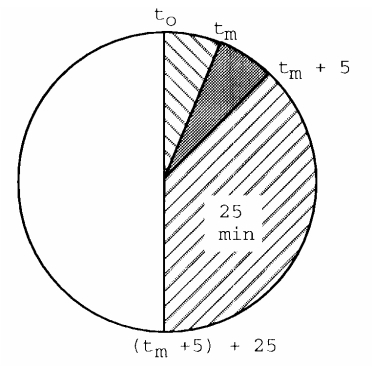
TEST VEHICLE IMPACT TYPE:

- Frontal (42.28 kph target velocity)
- Oblique (42.28 kph target velocity) with - ° barrier face first contacting - (driver/passenger) side

X Rear Moving Barrier (42.28 kph target velocity)

- Lateral Moving Barrier (32.19 kph target velocity)

FUEL SPILLAGE MEASUREMENT:



		ACTUAL	MAX ALLOWED
1.	From impact until vehicle motion ceases	0	28 g
2.	For five minute period after vehicle motion ceases	0	28 g.
3.	For next 25 minutes	0	28 g/min.

SOLVENT SPILLAGE DETAILS:

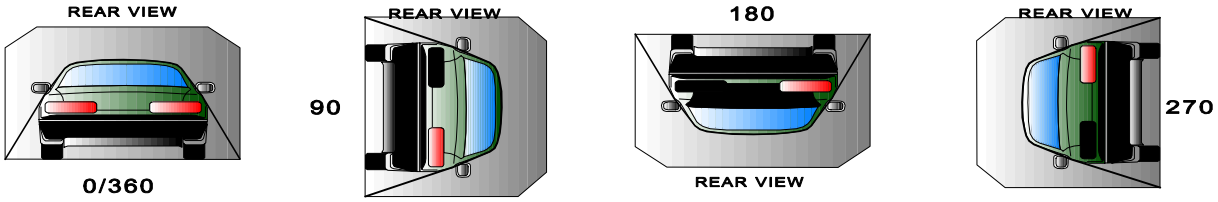
None

DATA SHEET 5

STATIC ROLLOVER TEST DATA

Table 7 FMVSS NO. 301 - STATIC ROLLOVER DATA SHEET

Vehicle: 2003 Volvo V70 Station Wagon NHTSA No.: C35900



I. DETERMINATION OF SOLVENT COLLECTION TIME PERIOD:

Rollover Stage	Rotation Time (spec. 1 -3 min)				FMVSS 301 Hold Time		Total Time				Next Whole Minute Interval	
0º - 90º	1	minutes	14	seconds	5	minutes	6	minutes	14	seconds	7	minutes
90º - 180º	1	minutes	3	seconds	5	minutes	6	minutes	3	seconds	7	minutes
180º-270º	1	minutes	5	seconds	5	minutes	6	minutes	5	seconds	7	minutes
270º-360º	1	minutes	11	seconds	5	minutes	6	minutes	11	seconds	7	minutes

II. FMVSS 301 REQUIREMENTS: (Maximum allowable solvent spillage):

First 5 minutes from onset of rotation	6th min.	7th min.	8th min. (if required)
142 g	28 g	28 g	28 g

III. ACTUAL TEST VEHICLE SOLVENT SPILLAGE:

Rollover Stage	First 5 minutes from onset of rotation (g)	6th min. (g)	7th min. (g)	8th min. (if required) (g)
0º - 90º	0	0	0	-
90º - 180º	0	0	0	-
180º-270º	0	0	0	-
270º-360º	0	0	0	-

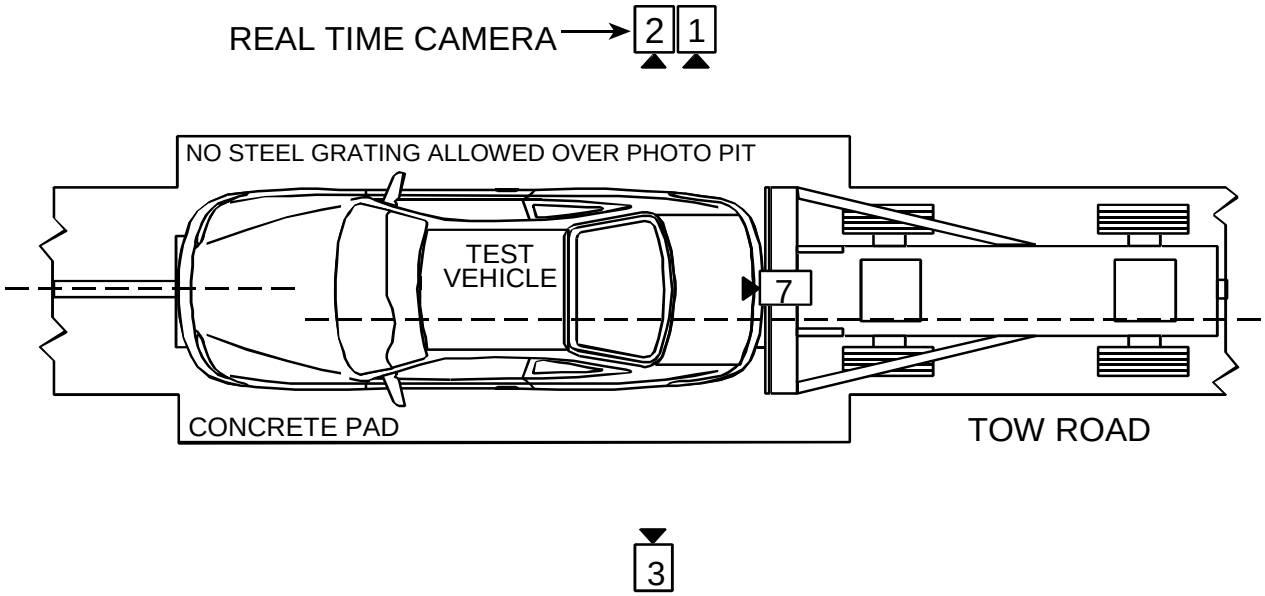
Note: Record spillage for whole minute intervals only as determined above.

IV. SOLVENT SPILLAGE LOCATION(S):

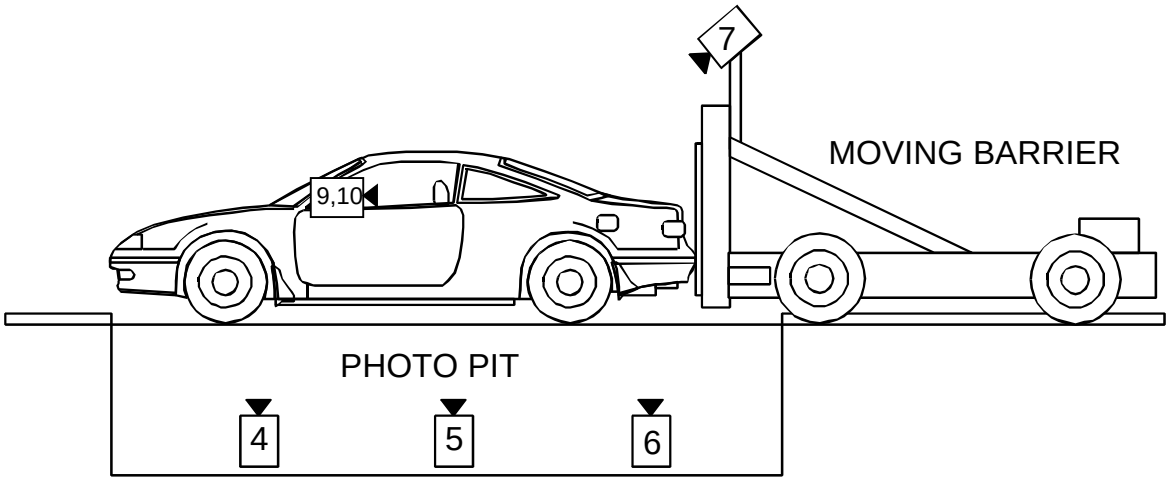
Rollover Stage	Spillage Location
0º - 90º	None
90º - 180º	None
180º-270º	None
270º-360º	None

DATA SHEET 6

HIGH SPEED CAMERA LOCATIONS



TOP VIEW



LEFT SIDE VIEW

DATA SHEET 6 (continued)

HIGH SPEED CAMERA LOCATIONS

NHTSA No. : C35900 Vehicle : 2003 Volvo V70 Station Wagon

CAMERA NO.	VIEW	CAMERA POSITIONS (mm)*			ANGLE** (degrees)	LENS (mm)	SPEED (fps)
		X	Y	Z			
1	Real-Time Camera	-	-	-	-	-	24
2	Right Side View	15900	1700	1080	-1	35	740
3	Left Side View	16550	2500	1140	0	35	500
4	Vehicle Front Underbody View	0	3430	-1956	90	13	1000
5	Vehicle Mid-Section Underbody View	0	2000	-1956	90	13	1020
6	Vehicle Rear Underbody View	0	900	-1956	90	13	1000
7	Moving Barrier View	0	0	2515	-105	13	1000
8	Overhead Overall View	-508	0	9804	-90	13	1005
9†	Onboard Driver View	960	2781	1050	-12	8	500
10†	Onboard Passenger View	822	2815	1050	-4	8	500

* X = film plant to monorail centerline (+ to left of rail)
Y = film plane to impact location (+ ahead of impact location)
Z = film plane to ground (+ above ground)
** = referenced to horizontal plane

† Research cameras.

Appendix A

PHOTOGRAPHS

LIST OF PHOTOGRAPHS

Figure A-1 PRE-TEST FRONT VIEW

Figure A-2 POST-TEST FRONT VIEW

Figure A-3 PRE-TEST LEFT SIDE VIEW

Figure A-4 POST-TEST LEFT SIDE VIEW

Figure A-5 PRE-TEST RIGHT SIDE VIEW

Figure A-6 POST-TEST RIGHT SIDE VIEW

Figure A-7 PRE-TEST REAR VIEW

Figure A-8 POST-TEST REAR VIEW

Figure A-9 PRE-TEST LEFT FRONT THREE-QUARTER VIEW

Figure A-10 POST-TEST LEFT FRONT THREE-QUARTER VIEW

Figure A-11 PRE-TEST RIGHT REAR THREE-QUARTER VIEW

Figure A-12 POST-TEST RIGHT REAR THREE-QUARTER VIEW

Figure A-13 PRE-TEST FRONT UNDERBODY VIEW

Figure A-14 POST-TEST FRONT UNDERBODY VIEW

Figure A-15 PRE-TEST REAR UNDERBODY VIEW

Figure A-16 POST-TEST REAR UNDERBODY VIEW

Figure A-17 CERTIFICATION PLACARD

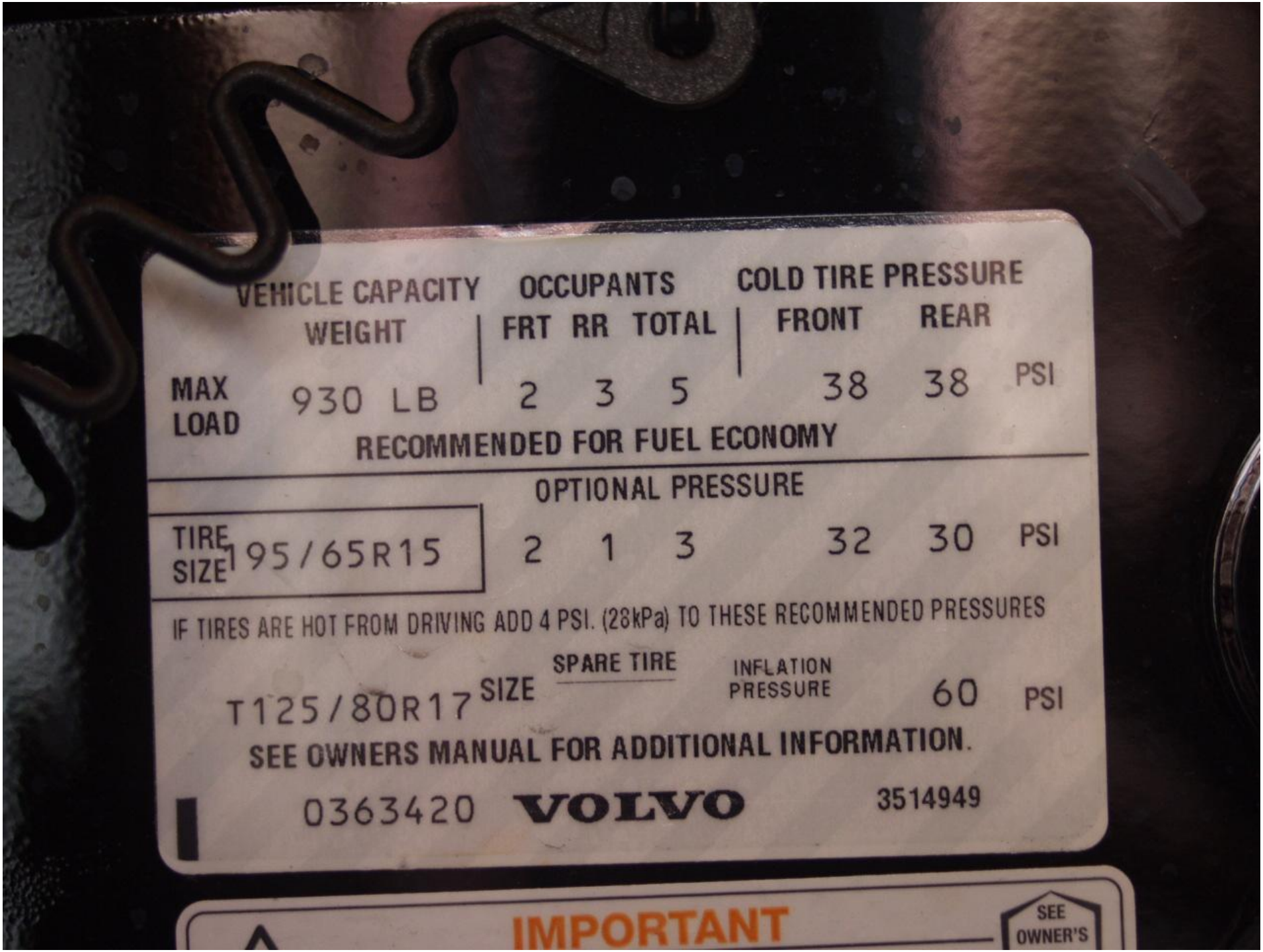


Figure A-18 TIRE PLACARD

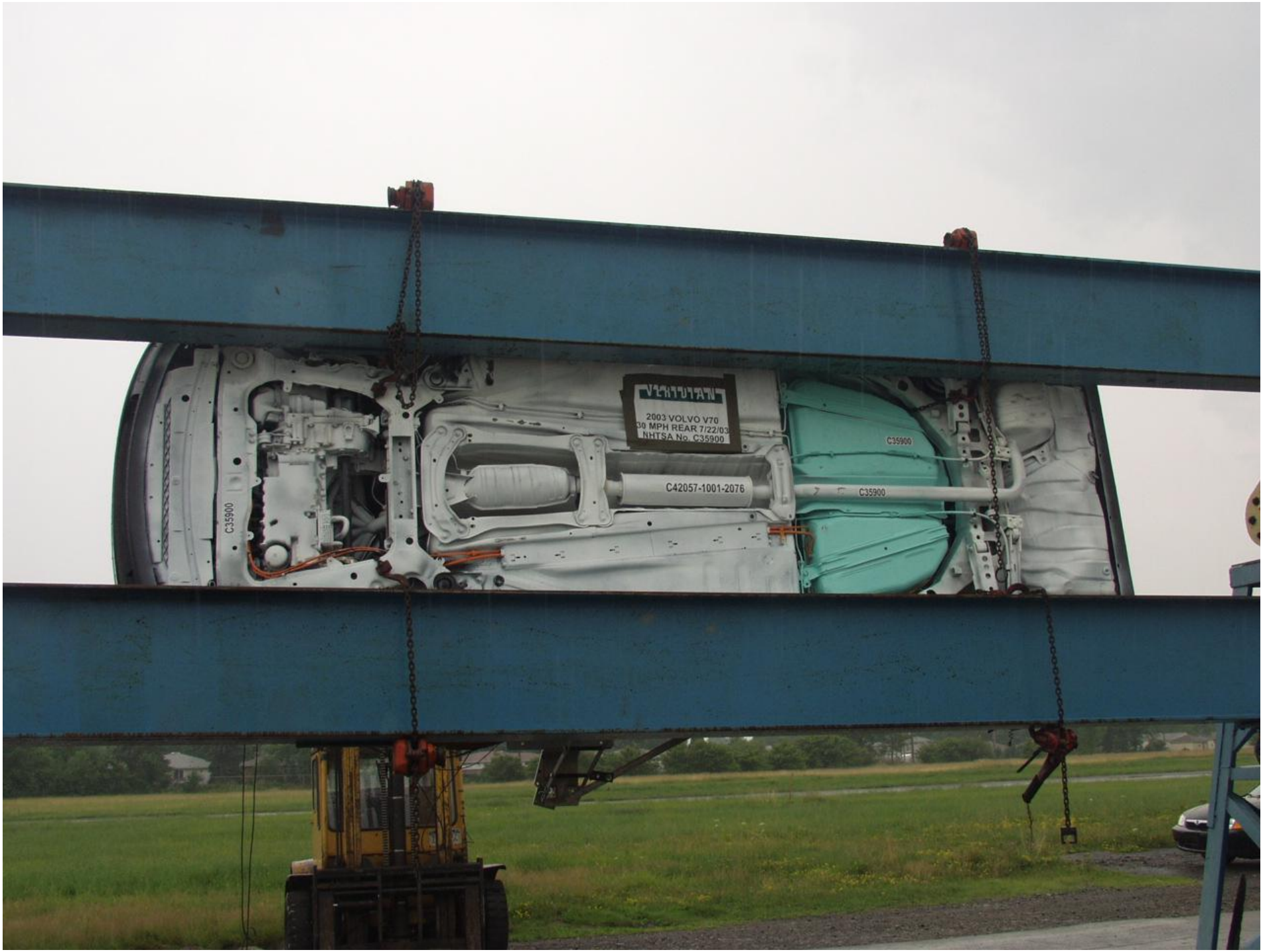


Figure A-19 ROLLOVER 90º

Figure A-20 ROLLOVER 180º

Figure A-21 ROLLOVER 270º

Figure A-22 ROLLOVER 360º